

January 17, 2003

Cocoa, Florida

Sponsored by:

DOE - Atlanta Regional Office

Florida Solar Energy Center

Photovoltaics: Installation and Operation

Presented by: Peter DeNapoli - Shell Solar

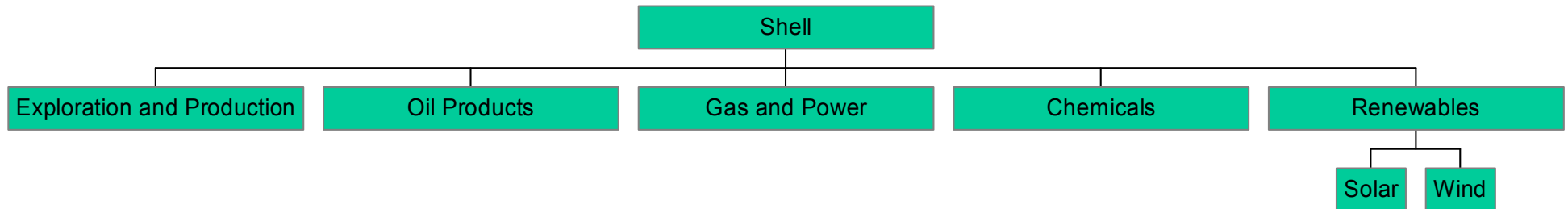


- Shell Solar Overview
- earthsafe Overview
 - The earthsafe kit
 - The 5 Es - What is the value proposition for a grid-connected PV system
 - Who installs earthsafe
- Installation and Operation of es100HV
 - Component Certification
 - Typical Installation



Shell Solar Overview

Royal Dutch/Shell Group Structure



Shell Solar Overview

Why is Shell in Renewable Energy?

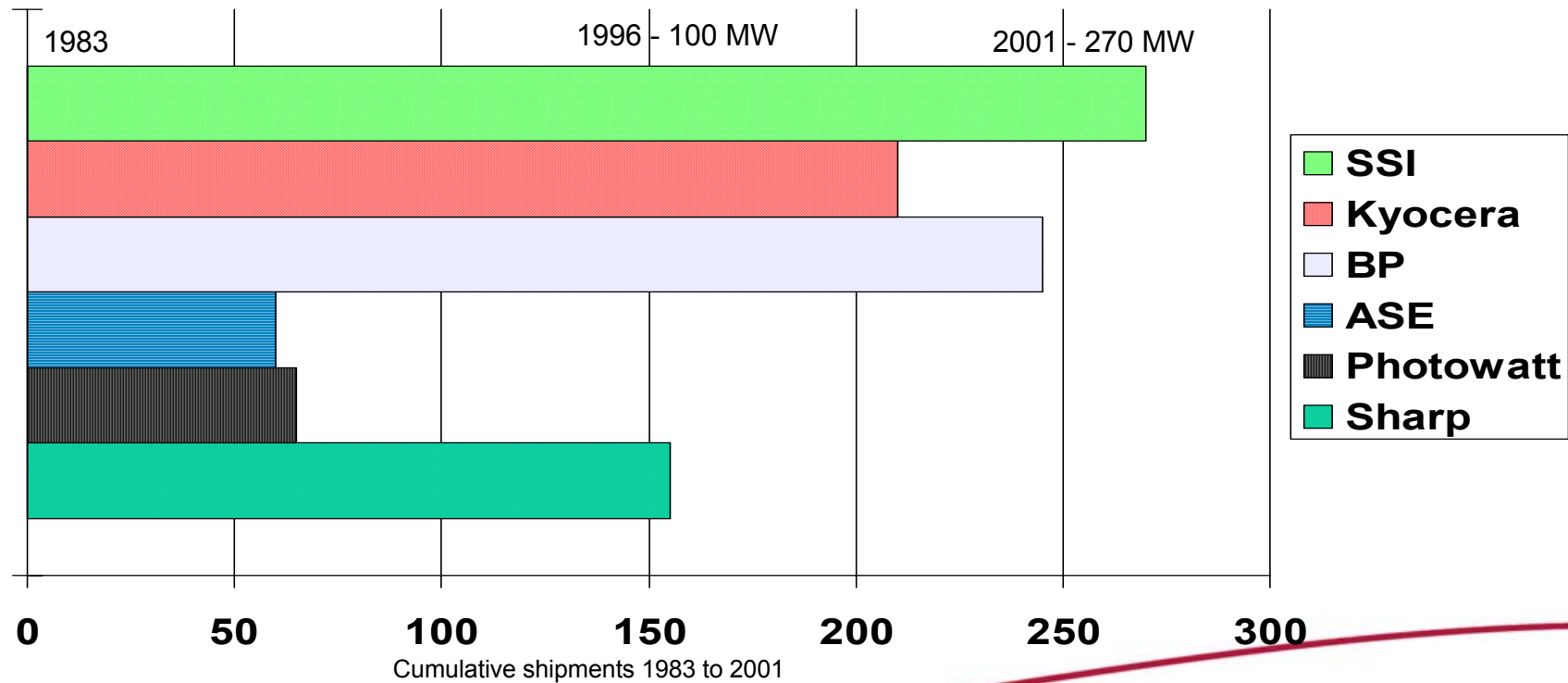
- Strategic – development of fossil fuels (stone age did not end because of lack of stones)
- Increased energy demand (growing world population, economic growth)
- Sustainable development – people, planet, profit
- In 20 - 30 year at least one source of renewable energy will have established itself



Shell Solar Overview

Shell Solar - An Industry Leader

- Leading PV system solution provider in the world
- Largest installed product base of all manufacturers



Shell Solar Overview

World-Wide ISO Manufacturing

Vancouver, WA

crystal fabrication

Camarillo, CA

wafer fab

cell fab

module fab

Gelsenkirchen, Germany

cell fab

Evora, Portugal

module fab

Japan (JV with Showa Shell)

module fab



Shell Solar Overview

Position & objectives for solar

Present position:

- Over 15 years experience in PV
- Acquired 100% of Siemens Solar (Jan 2002):
- Mono, Multi CZ and CIS (thin-film) technologies
- > 60 MW production capacity

Objectives:

- Continue as leading player globally
- Grow with the market
- #1 or #2 in EU and US
- Focus grid, industrial, rural markets
- Cash positive by 2005



earthsafe™ Overview



. The earthsafe kit

earthsafe™ 100HV Features:

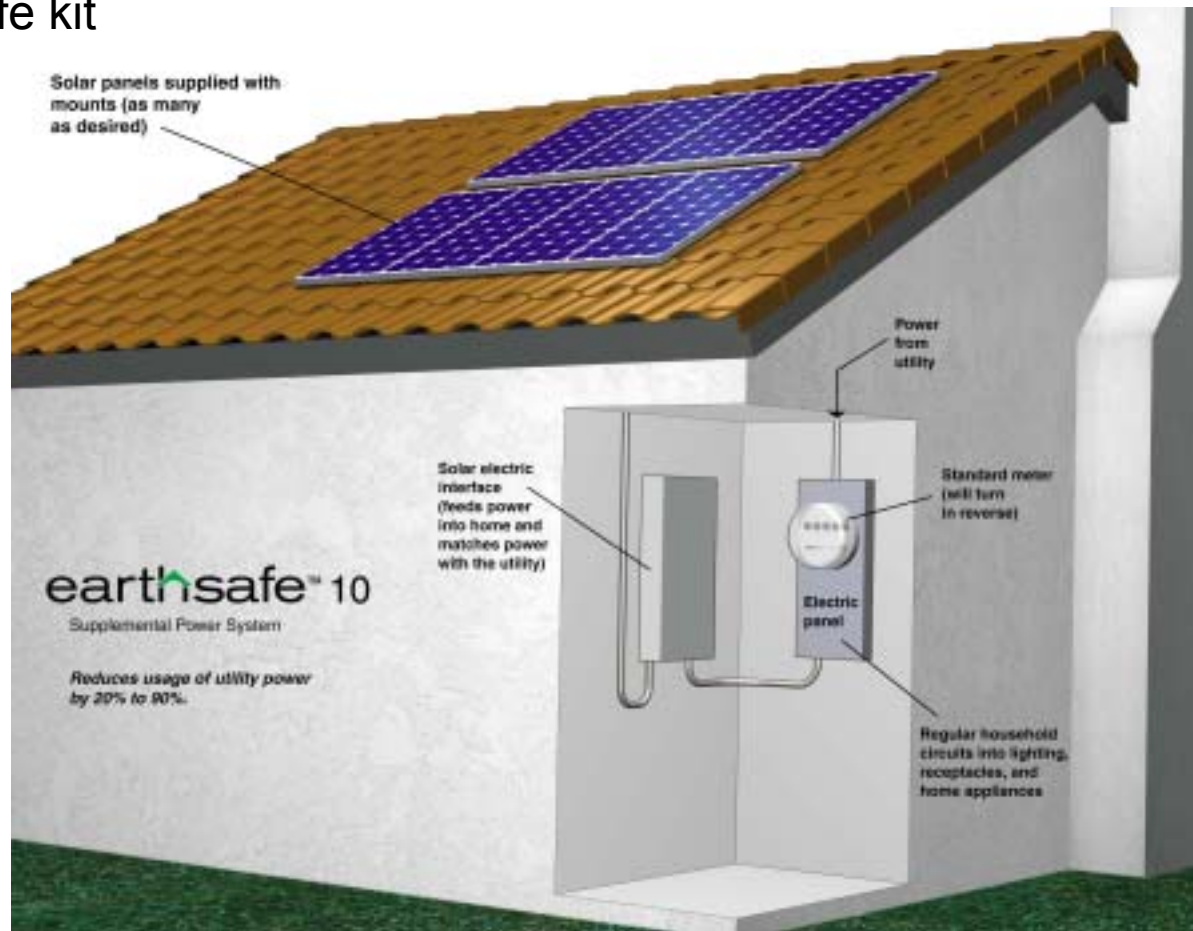
- Standardized kit (appliance)
- Low-cost components and easy/fast installation
- Simplicity of operation
- Uses Large format PV modules: SP140-PC (quick-connects)
- Uses 2.5 kW inverter, multiple units can be used, excellent modularity
- All components are of the highest quality, matched and certified
- Key goal: allow a high quality system to be installed in the shortest amount of time in the most efficient manner



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. The earthsafe kit

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A Shell Renewables company



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. The earthsafe kit

- Two system platforms offered:
- es 100-1380HV = 1680 watts DC, 1350 watts AC
- es 100-3080HV = 3080 watts DC, 2500 watts AC
- Both systems utilize 2500 watt AC SMA Inverter
- Options:
 - various mounts
 - remote monitoring and data collection



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. The earthsafe kit

System Performance

earthsafe 10 / 100 Systems

| earthsafe 10 / 100 Systems | | | | | | | |
|--|----------|---------------------|----------|-----------------|---------------|-----------------|---------------|
| Contents | | | | Performance | | | |
| # Solar Modules | | | | DC | | AC* | |
| earthsafe System | SP75 | Roof mount hardware | Inverter | Voltage (Volts) | Power (watts) | Voltage (Volts) | Power (watts) |
| Model 10-18HV | 24 | 6 | 1 | 400 | 1800 | 240 | 1500 |
| Model 10-30HV | 40 | 10 | 1 | 340 | 3000 | 240 | 2500 |
| earthsafe System | SP140-PC | Roof mount hardware | Inverter | Voltage (Volts) | Power (watts) | Voltage (Volts) | Power (watts) |
| Model 100-1680HV | 12 | 3 | 1 | 400 | 1680 | 240 | 1350 |
| Model 100-3080HV | 22 | 6 | 1 | 365 | 3080 | 240 | 2500 |
| Note: * AC power output is based on AC power produced by the system during bright sunlight conditions. | | | | | | | |
| System performance may vary based on the specific location and weather conditions. | | | | | | | |
| 20% loss estimate used for DC to AC conversion. | | | | | | | |



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. The earthsafe kit

System Dimensions

| earthsafe 10 / 100 Systems | | | | | | | |
|---|------------------|---------------------|-------------|------------|------------|---------------------------|--------------|
| Contents | | | Dimensions | | | | |
| earthsafe System | SP75 Modules | Roof mount hardware | Length (in) | Width (in) | Depth (in) | * Area (ft ²) | Weight (lbs) |
| Model 10-18HV | 24 | 6 | | | | 172 | 400.8 |
| Model 10-30HV | 40 | 10 | | | | 287 | 668 |
| earthsafe System | SP140-PC Modules | | | | | | |
| Model 100-1680HV | 12 | 3 | | | | 174 | 530 |
| Model 100-3080HV | 22 | 6 | | | | 290 | 668 |
| Note: Each panel of four SP140-PC modules measures approx. 134" x 64" and weighs approx. 175 pounds | | | | | | | |
| | | | | | | | |
| | | | | | | | |



earthsafe™ Overview

- . The 5 Es - What is the value proposition for a grid-connected PV system
 - Environment
 - Energy
 - Early adopters
 - Economics
 - Elderly - Mature, Sophisticated



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- The 5 Es - What is the value proposition for a grid-connected PV system

Environment

- Clean and green production of electricity
- Legacy: making a difference, think globally, acting locally
- Energy payback of a typical solar module is 3.3 years
- Emissions offset for each 2 kilowatt system every year:
 - 2 pounds of oxides of nitrogen
 - 9,039 pounds of carbon dioxide
 - The equivalent of driving your car 11,298 miles per year
 - The carbon dioxide absorbed by 1 acre of trees



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. The 5 Es - What is the value proposition for a grid-connected PV system

Energy

- Provides energy independence from the utilities
 - Many consumers resent their utilities as a “tax” on their lives
 - Stress the attribute of “giving it back” (electricity) to the utilities
- Reliable and Safe
 - 82% of owners consider reliability to be Very Important (CEC Study)
 - No moving parts to wear out, minimum of maintenance required
 - 76% consider safety as the second most important attribute (CEC Study)
 - Play up UL listed components, pre-engineered solution



earthsafe™ Overview

- The 5 Es - What is the value proposition for a grid-connected PV system

Energy

- Renting Vs. Owning
 - Like their home, an enduring asset Vs. an unending liability
 - System life ~ 30 years
 - 25-year solar module warranty
 - 5-year inverter warranty, 10-year extended warranty available
- Patriotic
 - Independence from foreign sources of energy
 - Assists with energy crises, past or future
- Their new hobby... Watch the meter run backwards



earthsafe™ Overview

- The 5 Es - What is the value proposition for a grid-connected PV system

Early Adopters

- Quick to try new things
 - Willing to put up with product issues in the early going
- Technographics
 - Many customers are professionals or engineers
 - Grew up with parents who were managers or professionals
 - They are computer literate and comfortable with technology
- Toy factor
 - Enjoy the latest technologies
 - Love monitoring features



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. The 5 Es - What is the value proposition for a grid-connected PV system

Economics

- Saves money!
- Offsets electricity use at the utility rates consumers pay
- Rebates/buydowns state tax
- Simple payback
 - System has life of more than 20 years
 - Typical homeowner do not live in their homes more than 10 years today
 - What is payback of a Cadillac Escalade? Hardwood floors? Of a 30-year T-Bill?



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- The 5 Es - What is the value proposition for a grid-connected PV system

Economics

- Incentives Make PV Systems A viable Economic Argument

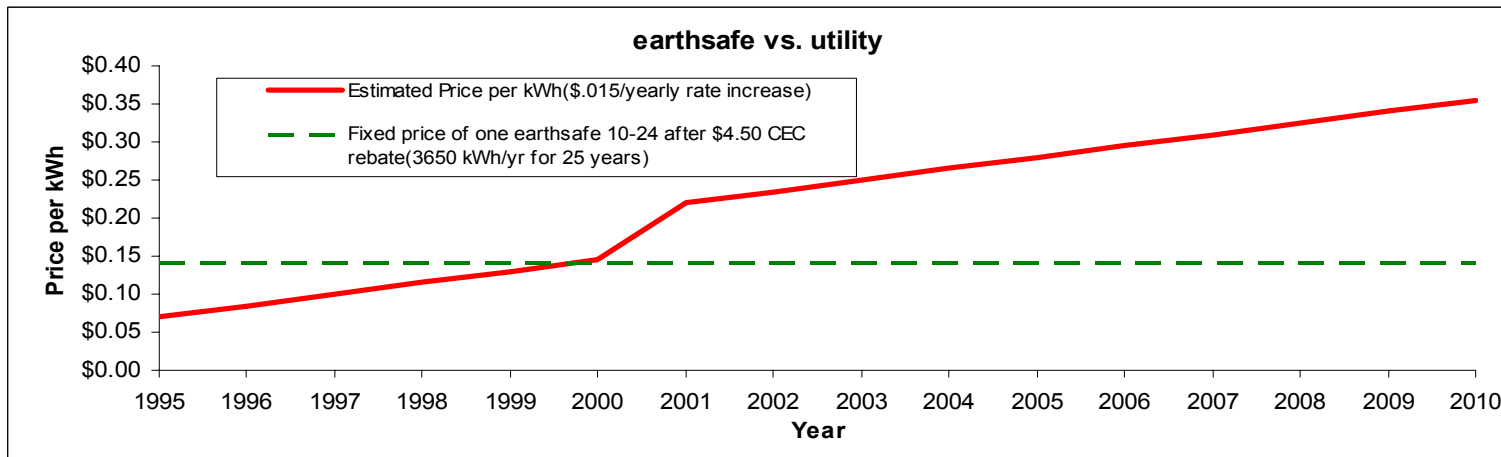


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. The 5 Es - What is the value proposition for a grid-connected PV system

Elderly - Mature, Sophisticated

- A high percentage of Matures find solar attractive
 - Insulation from future rate increases – soon on fixed income
 - Hedge against inflation “rates aren’t going to go down”
 - Typically have discretionary savings as part of their nest egg



Future Rate ?



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. Who installs earthsafe

Shell Solar's earthsafe systems and kits are sold only to and installed by:

- Trained
- Licensed
- Insured
- Professional
- Electrical, HVAC, Solar Contractors
- Utilities



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- Who installs earthsafe

Why is training required?



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- . Who installs earthsafe

Why is training required?





Model 100HV Systems Installation and Operation



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. Component Certification

- Utility Interconnection Requirements (inverter)
 - IEEE standard 929
 - UL standard 1741
- PV module/system
 - UL standard 1703 PV module
- NEC article 690 - Safety standard for PV system installation
 - article 230 disconnect means
 - article 240 overcurrent protection
 - article 250 grounding
 - article 300 wiring methods



earthsafe™ Overview

. Typical Installation

What do the different earthsafe model numbers mean?

- EXAMPLE: earthsafe 100-1680HV-3
- 100: Large format module i.e. SP140-PC
- 1680 : 1680 Watts DC
- HV : High Voltage
- 3 : 3 inch flashable mount, other flashable sizes include 4.5, 6, and 7.5 inches. Tile trac option also available.



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- Typical Installation

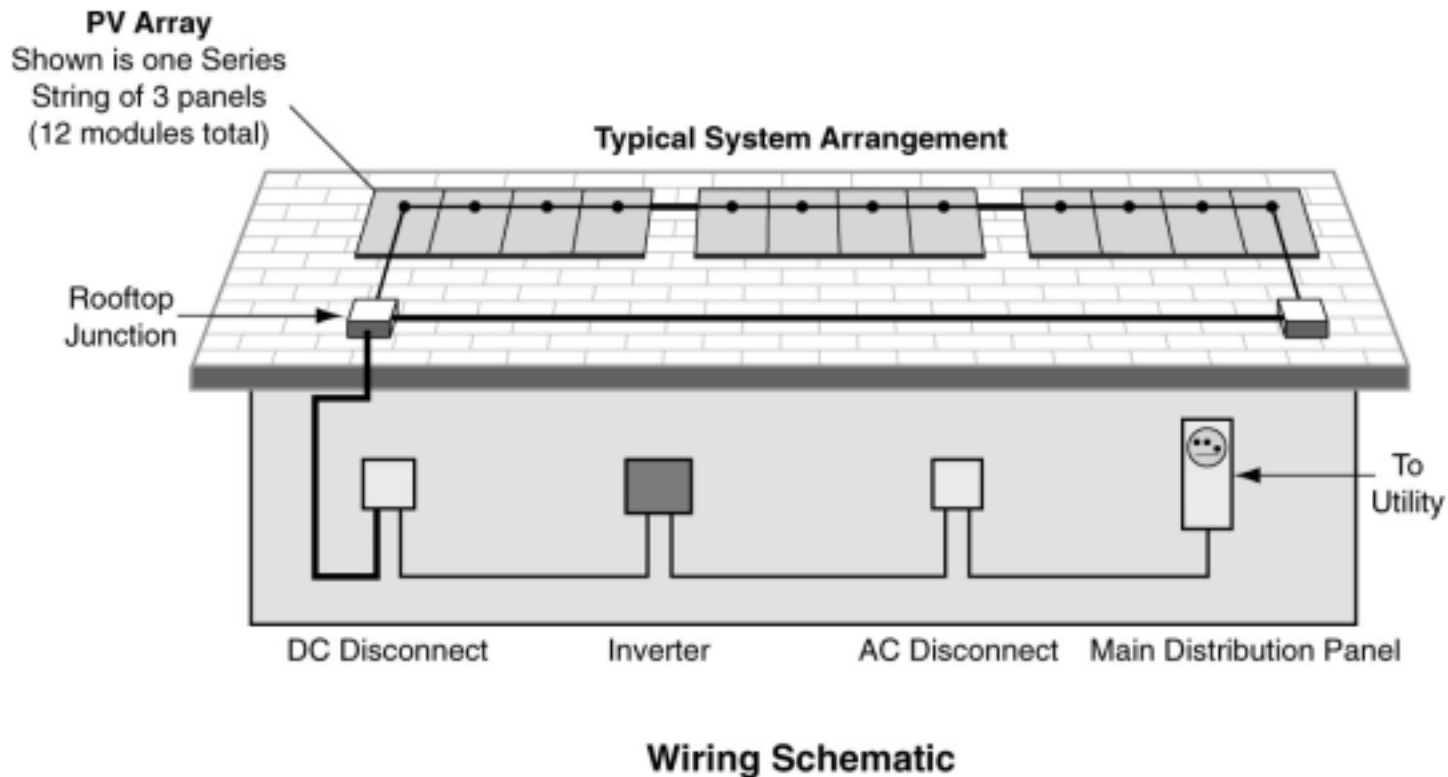


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. Typical Installation

es100-1680HV

Layout



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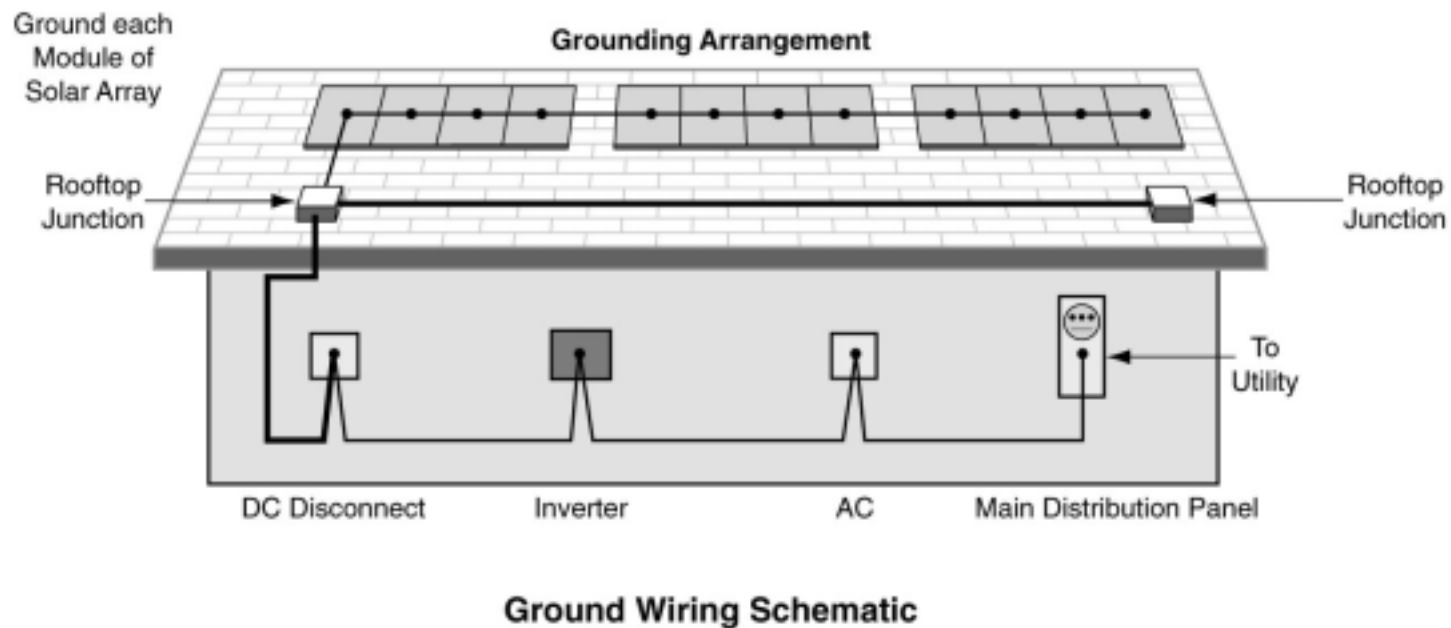
- Typical Installation



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. Typical Installation

es100-1680HV Grounding



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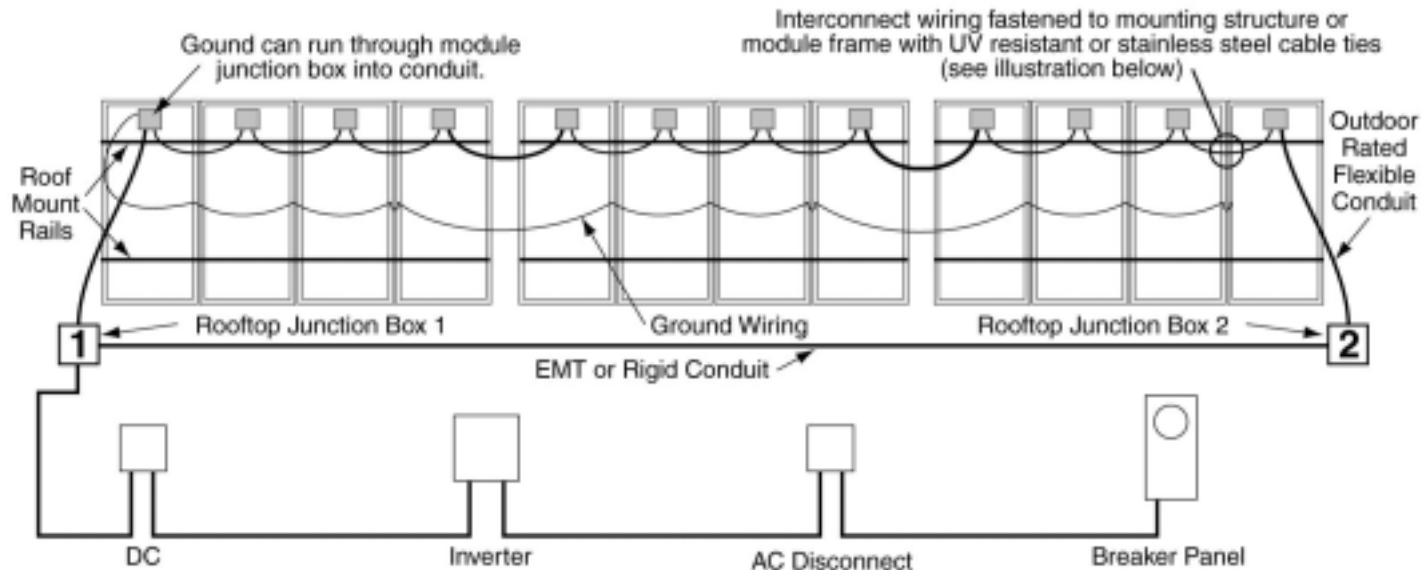
- Typical Installation



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. Typical Installation

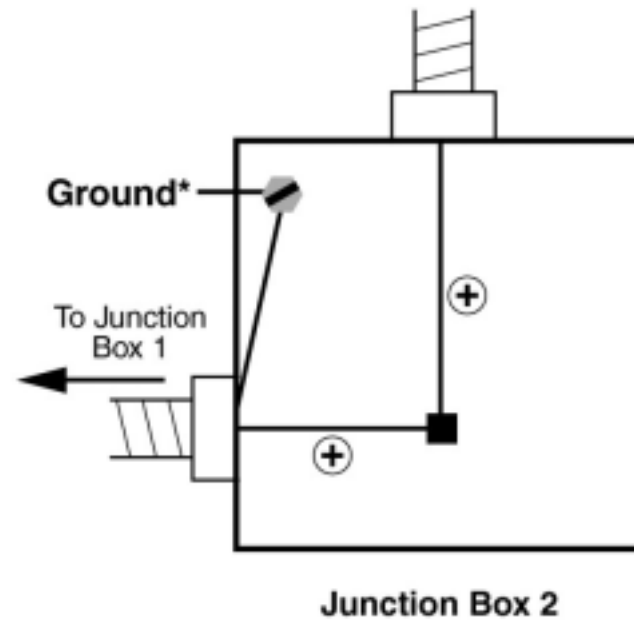
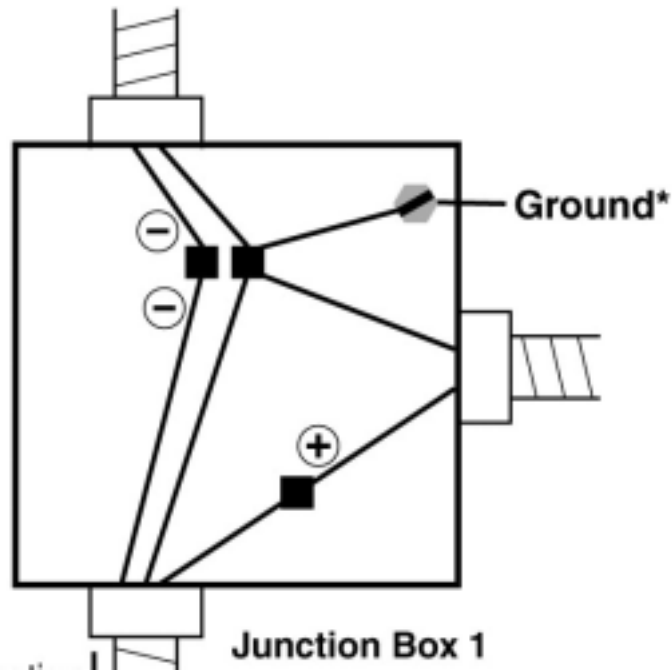
es100-1680HV Wiring (backside shown)



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. Typical Installation

es100-1680HV Wiring -junction boxes

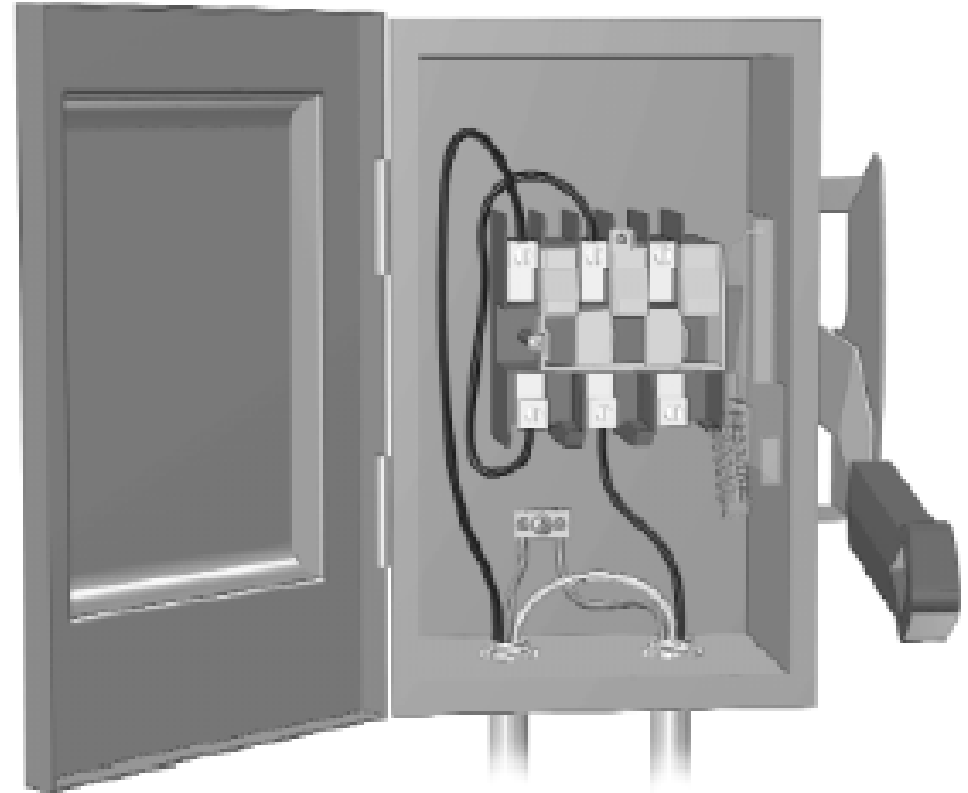


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. Typical Installation

es10-HV DC Disconnect

- Connect array wires to DC disconnect
- Connect output to inverter
- Connect ground to lug



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- Typical Installation

DC Disconnect



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· Typical Installation

HV Inverter



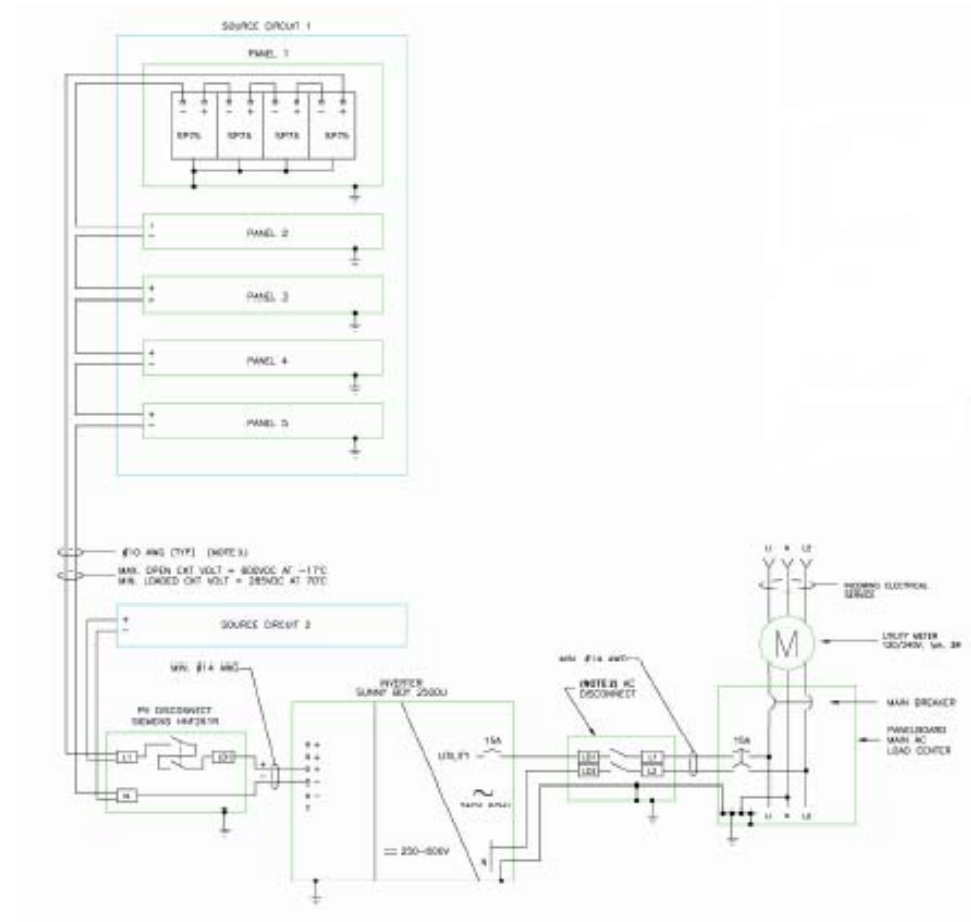
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. Typical Installation

es100-1680/3080HV Schematic



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· Typical Installation

Happy Owner!



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. Typical Installation

Warranty Responsibility

- SP140-PC PV Module - 25 year warranty
 - Shell Solar handles module warranty claim directly
- SMA 2500 Inverter - 5 year warranty
 - SMA America handles inverter warranty claims directly
- Installation - Typically 1 year
 - Contractor handles installation issues directly



Thank you!
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